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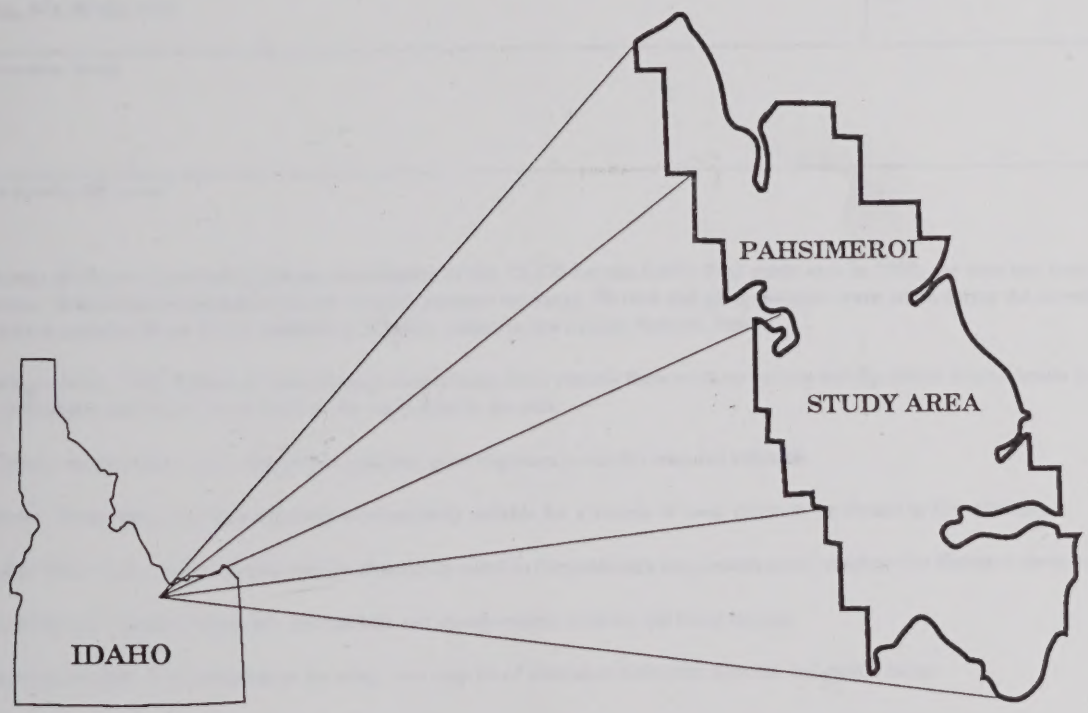

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BUREAU OF MINES

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16. Abstract (Limit: 200 words)

The Bureau of Mines conducted a mineral investigation of the 32,270-hectare Cache Peak study area in 1992; the area had been proposed as wilderness. Bureau personnel examined and sampled prospect workings; 50 rock and placer samples were taken during the investigation. The study area is centered about 25 km southeast of Challis, Idaho, in the Challis National Forest.

According to May, 1993, Bureau of Land Management mining claim records there were no current mining claims located inside the study area. Up to 100 claims may have been located in the study area in the past.

Gold, silver, copper, lead, zinc: Significant analyses, poor exposure precludes resource estimate.

Limestone: More than 1 billion tonnes may be chemically suitable for a variety of uses, markets too distant to favor mining.

Dolomite: More than 1 billion tonnes may be chemically suitable for producing magnesium metal, markets too distant to favor mining.

Sand and Gravel: Several million m^3, but markets and transportation costs do not favor mining.

Chalcedonic nodules: Two localities in the study area may be of interest to hobbyists who cut and polish stone.

There is no reported past production from the study area.

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MINERAL RESOURCES OF THE PAHSIMEROI STUDY AREA, CUSTER COUNTY, IDAHO

By
Alan R. Buehler

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PREFACE

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Bureau of Mines and U.S. Geological Survey to survey certain areas of Federal lands ". . . to determine the mineral values, if any, that may be present . . ." Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a Bureau of Mines mineral investigation of the Pahsimeroi study area, Custer County, Idaho, including most of the lands in Roadless Area S4-209, classified as a Further Planning unit, and Area N4-209, classified as Non-Wilderness Recommended, during the Second Roadless Area Review and Evaluation (RARE II) by the Forest Service, January 1979, and other contiguous National Forest land. Subsequent legislative proposals have recommended the study area be classified as Wilderness. Mining activities in the study area would be severely restricted under this designation.

This open-file report contains data gathered and interpreted by personnel of the Bureau of Mines, Western Field Operations Center, Branch of Resource Evaluation, East 360 Third Avenue, Spokane, WA 99202. The report has not been edited or reviewed for conformity with Bureau of Mines editorial standards.

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UNITS OF MEASURE, ABBREVIATIONS, AND SYMBOLS USED IN THIS REPORT

To conform to the Omnibus Trade and Competitiveness Act of 1988 and Executive Order 12770, dated July 25, 1991, measurements made during this study are reported in metric units. Conversions have been done using Federal Standard 376A, May 5, 1983, *Preferred metric units for general use by the Federal Government*, General Services Administration.

cm	centimeter (cm x 0.3937 = inch)
°C	degree Centigrade (°C x 9/5+32 = °F)
km	kilometer (km x 0.6214 = mile)
km^2	square kilometer (km^2 x 0.3862 = $mile^2$)
m	meter (m x 3.281 = foot)
m^3	cubic meter (m^3 x 1.3079 = $yard^3$)
%	percent
ppb	part per billion
ppm	part per million

SUMMARY

A mineral survey of the approximately 32,270-hectare Pahsimeroi study area was conducted by the USBM (U.S. Bureau of Mines) in 1992. The area includes most of the land in the Pahsimeroi RARE II roadless areas (No. S4-209, 22,640 hectares of land recommended for further planning; and No. N4-209, 14,900 hectares of land recommended as non-wilderness) and other contiguous National Forest land. The study area is in Challis National Forest in southeast Idaho, centered about 25 km southeast of Challis, Idaho.

The area is near the northern limit of the Basin and Range physiographic province and is underlain by limestone, dolomite, mudstone, sandstone, quartzite, and Challis volcanic rocks. The area studied includes the northern half of the Pahsimeroi Mountains and is centered around Table Mountain. It includes some of the tallest peaks in Idaho and has been heavily glaciated. Large alluvial fans spread out east and west from valleys originating in the study area, and small portions of the fans are included on the west side.

There are no current mining claims and no oil and gas or geothermal energy leases or applications. No mineral commodities in the study area are currently minable, there has been no reported production. Prospect workings found during the study were collapsed and the mineralized structures were no longer exposed; resources at the sites could not be calculated.

Dolomite and limestone inferred reserve bases exceed 1 billion tons each within the Pahsimeroi study area. The materials are widespread and of high quality. Extensive sampling and more detailed mapping are required to better define the resources. While ample dolomite and limestone resources occur nearby, outside the study area, most of the material is within other areas that have been proposed as wilderness. Dolomite is the main constituent of several geologic formations within the study area. Sample analyses indicate that the more than 350-m-thick (1,150 ft) Jefferson Dolomite is the most pure and is equivalent to material being mined at a dolomite-to-magnesium processing plant near Addy, Washington.

Limestone and dolomite have been used for aggregate, rip-rap, and building stone near the study area and possibly for the manufacture of portland cement. While the limestone, dolomite, and limited amounts of sand and gravel found within the study area could be used for these purposes in the future, occurrences outside the study area are numerous and sufficient to supply local demand.

There are five localities inside the study area boundary where historical mining activity was found; 4 lode and 1 placer. Lode workings explore small barite veins in dolomite northwest of Grouse Creek and quartz veins in argillaceous limestone south of Grouse Creek and north of Gooseberry Creek; placer test pits were found in Christian Gulch. Exploration at the barite occurrence is warranted to determine if the structure widens at depth. It also carries anomalous gold, lead, and zinc.

Chalcedonic nodules lined with quartz crystals (some amethystine) were seen approximately 2 km northwest and 2 km south of Table Mountain. They may be of interest to rockhounds and mineral collectors.

No oil, gas, placer, or geothermal resources were identified.

INTRODUCTION

This report describes the USBM study to evaluate the mineral resources and mineral development potential of the Pahsimeroi study area, Custer County, Idaho. The study area includes land that was proposed for wilderness designation by Congress.

The pre-field and field evaluation portions of the study were conducted in 1992. Individual prospects and mineralized areas were examined to identify mineral and energy resources within the study area. Results of the investigation will be used to help determine the suitability of the Pahsimeroi study area for inclusion into the National Wilderness Preservation System. Although the immediate goal of this and other USBM mineral surveys is to provide data for the President, Congress, government agencies, and the public for land-use decisions, the long-term objective is to help ensure that our country has an adequate, dependable supply of minerals and materials to meet its national security and economic needs at acceptable social, environmental, and economic costs.

Geographic Setting

About 32,270 hectares of the Forest Service's 23,040-hectare Pahsimeroi Mountains and 26,600-hectare North Pahsimeroi Management Units (Nos. 17 and 19, respectively) was studied (fig. 1). The area, in southeast Idaho, includes most of the Pahsimeroi RARE II Further Planning unit (S4-209) of 22,640 hectares, the Non-Wilderness Recommended unit (N4-209) of 14,900 hectares, and other contiguous National Forest land. The study area's northern boundary is about 10 km east of Challis, and its southern terminus is 12 km north-northeast of Dickey (fig. 1). The southern boundary of the study area is near the Borah Peak study area which was examined by Capstick and others (1987).

The 40-km-long by 10-km-wide study area trends north-northwest along the Lost River Range and includes the northern part of the Pahsimeroi Mountains (fig. 2). Access into the foothills and canyons of the steep southwest-facing range front is by dirt roads from U.S. Highway 93. The southern end of the study area and the northern tip are bounded by Forest Service dirt roads. Other Forest Service dirt roads access the foothills and canyons along the northeast and southwest boundaries.

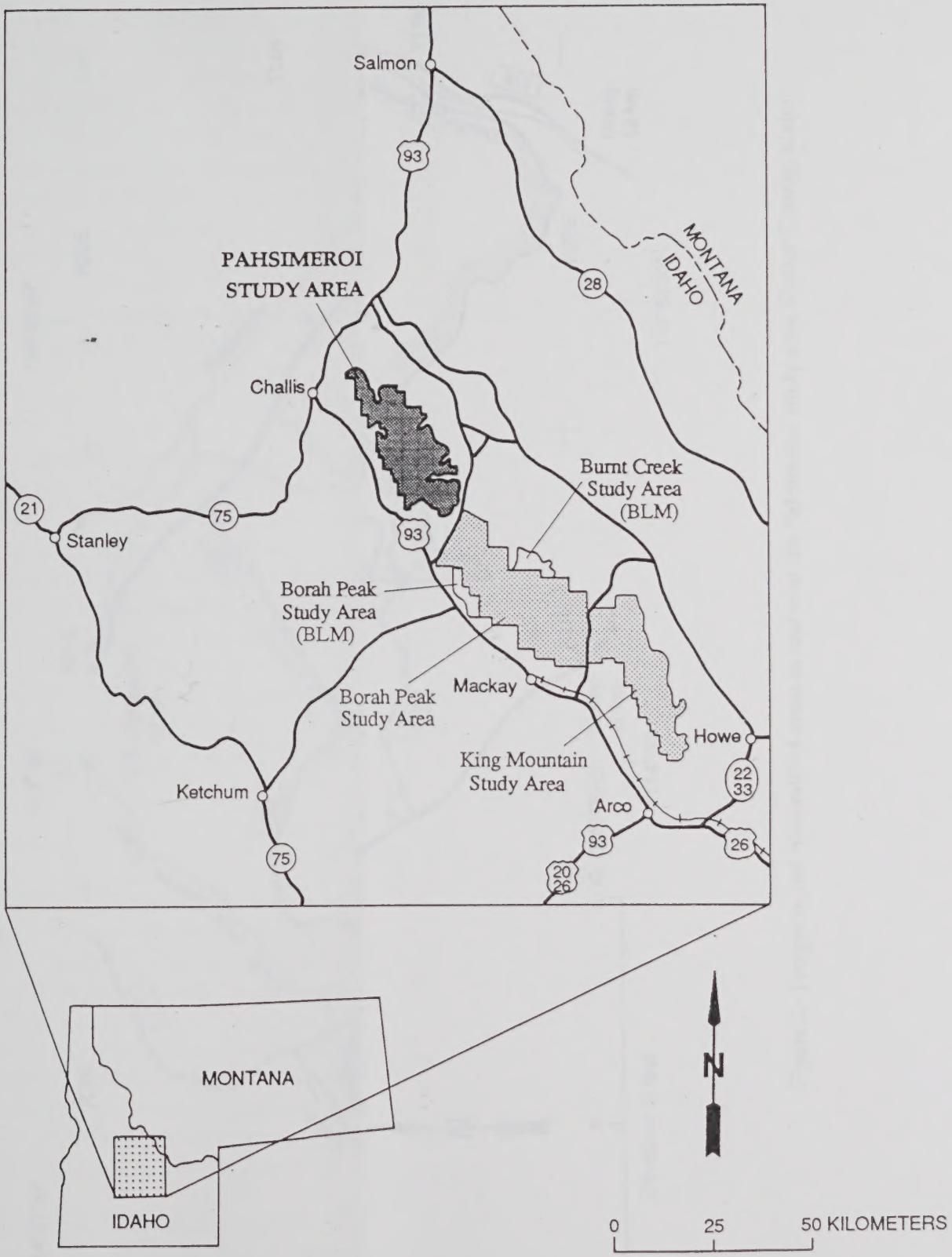


Figure 1.- Location of the Pahsimeroi study area, Custer County, Idaho

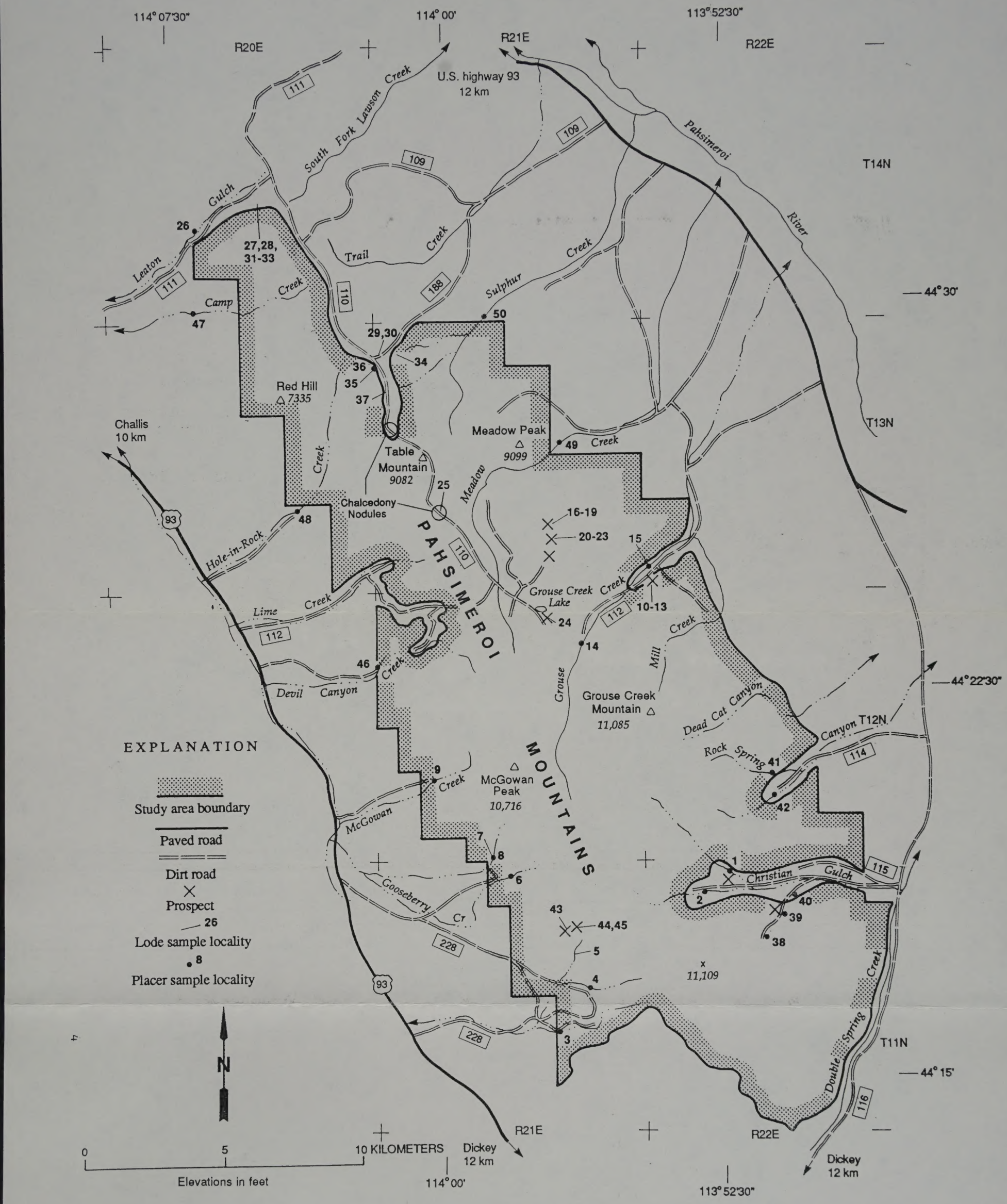


Figure 2.- Prospects and mineralized areas in and near the Pahsimeroi study area, Custer County, Idaho

The study area contains both high-desert and mountainous environments and is extremely rugged. High cliffs are numerous, and drainages are often narrow and steep. Relief from the foothills, along the western range front, to the summit of McGowan Peak is over 1,150 m and occurs within about 3 km. The highest point in the study area is a 11,109-ft-high (3,386 m) unnamed peak, 3 km north of the southern boundary. The lowest point in the study area is 6,040 ft (1,841 m), 1.6 km west-southwest of Red Hill on the west side of the area. Annual precipitation ranges from 18 to 25 cm in the lower foothills to 90 to 100 cm at higher elevations, most of which falls in the autumn and winter months as snow. Sagebrush and desert grasses grow in the lower areas. Where favored with sufficient ground water, meadow grass and aspen are present, particularly in glaciated valleys. As elevations increase, scattered pine and fir thicken to stands which dominate the scene to treeline.

Previous Studies

Both regional and detailed geological and geophysical studies have been done in and near the study area. The most recent detailed study (Stein and Bucknam, 1985) was of the 1983 Borah Peak earthquake along the Lost River Fault. Detailed geologic studies include those by Mapel and others (1965), Hays and others (1978), Rember and Bennett (1979), and Fisher and others (1983). Regional studies, generally concerned with structure and stratigraphy, include those by Ross (1963), Sandberg and others (1967), Oaks and others (1977), Skipp and Hait (1977), Warner (1977), Bond (1978), Reynolds (1979), Skipp (1981), and Ruppel (1982). Studies which include information on mining and mineral deposits in the vicinity are by Umpleby (1917), Ross (1947), MINOBRAS (1975), Ruppel (1982), Wong (1983), Gabby (1986), Capstick and others (1987), Miller (1989), McHugh and others (1991), and Peters (in preparation).

Present Study

The USBM investigation was conducted by personnel from WFOC (Western Field Operations Center), Spokane, Wash., during 1992 and consisted of prefield research, field work, and report preparation phases. Preliminary work included research of available geologic and mineral resource literature, mining claim records, and mine production data for properties in and near the study area. Owners of active, or recently active claims identified during a search of BLM (U.S. Bureau of Land Management) mining claim records were notified of the study. District and regional offices of the Forest Service were also contacted to obtain data on specific claim groups and other information pertinent to the study. Mitchell (1992) compiled geologic and mineral information for the Pahsimeroi area.

Fifty rock and placer samples were collected from the prospects and mineralized areas. The samples were of three types: 1) grab--rock pieces collected unsystematically from a dump, stockpile, or float (loose rock lying on the ground); 2) select--an intentionally biased selection of rock taken because of a unique or unusual

property; and 3) placer--a relatively small amount of material, usually stream sand and gravel, in which the heavy mineral fraction is concentrated by panning.

Placer samples were screened to -1 cm in the field. The samples were weighed and processed at WFOC where the heavy minerals fraction was concentrated on a shaking table. The concentrate was also checked for fluorescence and radioactivity. The magnetic and non-magnetic fractions of the heavy-mineral concentrate were separated and weighed and a microscopic examination was performed to identify minerals representing possible resources.

Both the rock samples and a split of the heavy mineral concentrate from the reconnaissance pan samples were sent to a commercial laboratory (IGAL, Inc., Cheney, Wash.). The samples were pulverized, mixed, split, and analyzed for 12 elements 1/ (measurable limits are listed with the elements).

Resource/reserve terminology of the U.S. Bureau of Mines and U.S. Geological Survey (1980) is used as a guideline in this report. Technical terminology complies with Thrush (1968) and Bates and Jackson (1980).

GEOLOGIC SETTING

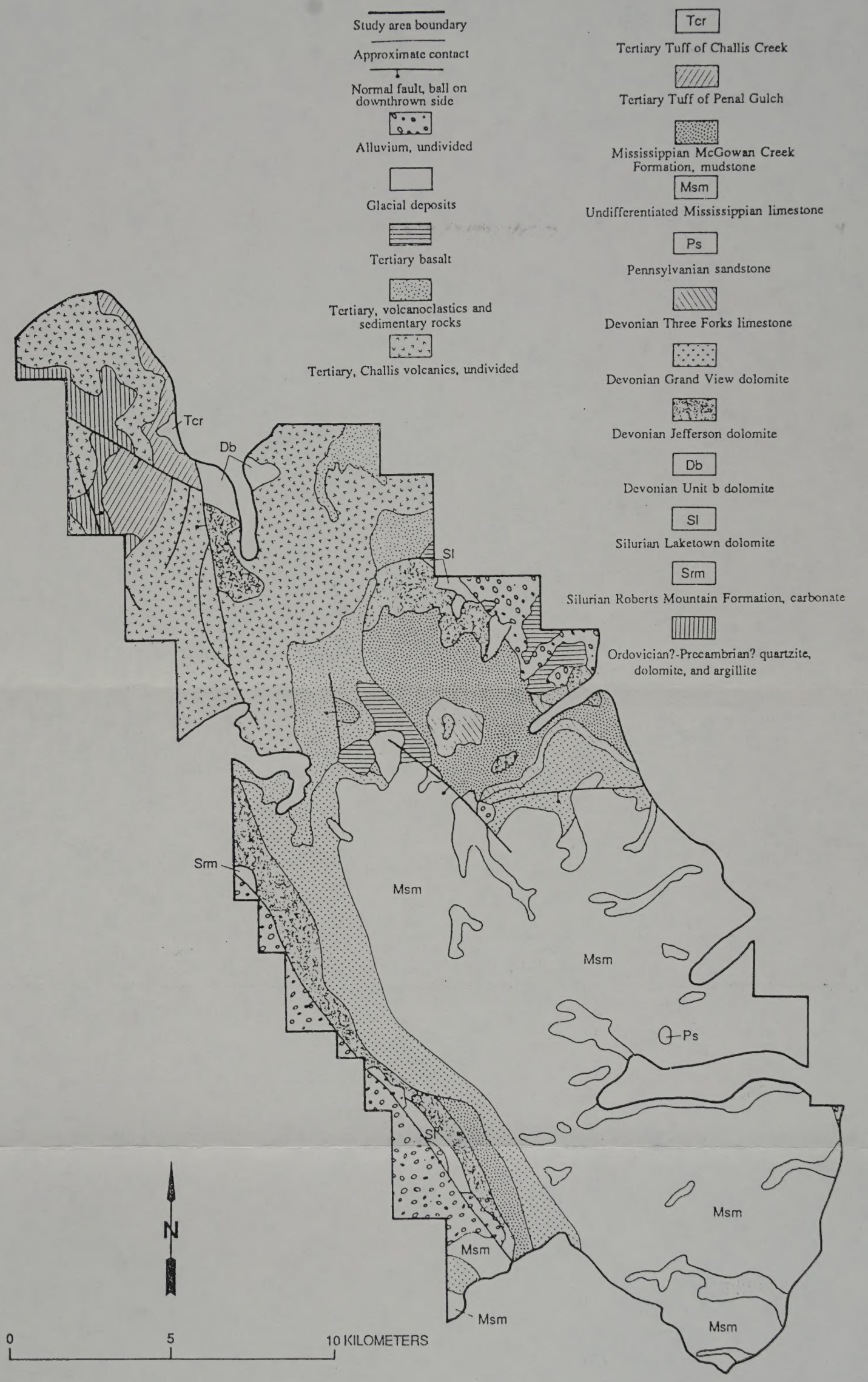
The Precambrian and Paleozoic rocks of the Lost River Range, which underlie the study area, are part of a large Mesozoic-age thrust plate (Skipp and Hait, 1977). The study area is characterized by extensive north-northwest-trending horst (uplifted block) and graben (downdropped block) structures typical of the Basin and Range province (Reynolds, 1979, p. 188). According to Rupell (1982, p. 16), recent faulting in the Lost River Range has concentrated on the western side of the range, tending to tilt the horst east-northeast. Faulting continues today; in 1983, the east side of the Lost River Fault, which extends along the western range-front, made an average relative vertical upward adjustment of 6.5 ft, causing the 7.1 magnitude Challis (Borah Peak) earthquake (Stein and Bucknam, 1985, p. iv and v-viii).

Ruppel (1985) stated that the abundant mineral deposits in the Lemhi Range to the northeast occur at the base of the Medicine Lodge Thrust (fault) and that similar deposits may occur at the base of that thrust where it is deeply buried beneath the Lost River Range. Hydrothermal fluids ascending from depth may have dissolved minerals from these deposits and transported them up along the high-angle fault systems to an environment favorable for deposition. The barite and quartz vein occurrences found in the study area may be a result of this remobilization and deposition.

1/ Gold (5 ppb), silver (0.2 ppm), arsenic (5 ppm), bismuth (5 ppm), copper (1 ppm), mercury (10 ppb), manganese (1 ppm), molybdenum (1 ppm), lead (2 ppm), antimony (5 ppm), tungsten (10 ppm), and zinc (1 ppm).

Paleozoic sedimentary rocks are the most common exposed within the study area (Rember and Bennett, 1979). The oldest rocks are Ordovician or older (Precambrian?) quartzite, dolomite, and argillite exposed in the vicinity of Camp Creek, at the north end of the area. Silurian- to Carboniferous-age dolomites and limestones of possible economic significance crop out over most of the study area (fig. 3). On the north end of the study area, Tertiary Challis Volcanic rocks overlie the sediments. Quaternary-age glacial deposits are abundant in the study area; particularly in valleys draining to the northeast. Unconsolidated alluvium covers semi-consolidated fanglomerates in the valleys.

Among the several dolomite formations in the study area, the Jefferson dolomite is probably the most economically significant. It crops out along the range front, on the west side of Table Mountain, and along Meadow Creek. The formation is composed mainly of dark bluish-gray dolomite. Analyses by Mapel and others (1965) indicate that the Jefferson is more pure and has fewer interbeds of quartzite that the dolomite in other nearby formations. The thickness of the formation in the study area is reported to be approximately 350 m (1,150 ft) (Mapel and others, 1965). Studies by Sloss and Laird (1946) lead them to regard the Jefferson dolomite in Montana as Upper Devonian in age.



Compiled by Mitchell (1992) from Hays and others (1978), Rember and Bennett (1979), and Fisher and others (1983)

Figure 3.- Geologic map of the Pahsimeroi study area, Custer County, Idaho

An undifferentiated Mississippian and Pennsylvanian limestone unit (to 1,500 m thick in places) of possible economic significance underlies most of the study area (fig. 3). The Three Forks, 10 to 60 m of argillaceous limestone, may also be economically significant. More detailed descriptions of the stratigraphy are available in Ross (1947, p. 1099-1125) and Mapel and others (1965).

MINING HISTORY

The first mining claims in the study area probably were located in the late 1800's, during the rush to the Alder Creek mining district, 6 km southwest of Mackay. About 100 lode claims, and possibly a few placer claims, may have been located since then. According to May 1993, BLM mining claim records there were no current claims in the study area.

Mining-related activity has taken place at five localities in the study area: 1) barite veins were explored on the ridge between Meadow and Grouse Creeks, 2) an iron oxide-stained shear zone was worked southeast of Grouse Creek Lake, 3) quartz veins were prospected south of Grouse Creek and 4) north of Gooseberry Creek, and 4) placer test pits were excavated in Christian Gulch. There is no reported production from any of the prospects.

No known claims have been located or mineral leases issued for industrial minerals in the study area. Study area limestone may have been mined for locally manufactured portland cement, and both the limestone and dolomite might have been used as dimension stone for building construction in Challis in the late 1800's.

Oil and gas lease applications were filed in August and September 1980 adjacent to the southeastern part of the study area in the vicinity of Dead Cat Canyon (fig. 2). Evidence of geophysical exploration for oil and gas was seen along the western side of the study area, where small seismic test sites were seen.

MINERAL COMMODITIES AND APPRAISAL

Mineralized areas and prospects in the study area were evaluated. Lode and placer sample localities are shown on figure 2 and analyses are reported in appendices A and B.

While no discussions of prospects outside the study area boundary are given in this report, analyses and descriptions of samples taken adjacent to the study area are also listed in appendices A and B. None contained economic concentrations of the metallic elements checked.

Base and Precious Metals

Benchmark Prospect

The property is on a relatively flat-topped mountain between Meadow and Grouse Creeks in the E1/2 E1/2 Secs. 27 and 34, T. 13 N., R. 21 E. Nothing is known of the history of the property. Workings include three small pits aligned north-south approximately 0.5 km apart. The pits explore narrow barite- and magnetite-rich shear zones associated with localized, brecciated silicification in tan, calcareous beds of the Grandview dolomite.

Eight samples (IPB-16-23) of selected mineralized material from two of the pits and from float more than 200 m away contained up to 17% barium, 123 ppb gold, 460 ppm lead, and 251 ppm zinc. None of the element concentrations are economic; however, they are significant. Although the mineralization in the pits is confined to a narrow zone in the dolomite, mineralized float in the vicinity indicates the zone is continuous for a long distance (about 200 m) at the surface. Exploration along the structure (particularly down dip) may reveal higher grade mineralization in a wider zone.

Grouse Creek Lake Prospect

The prospect is about 100 m southeast of Grouse Creek Lake in the SW1/4 NE1/4 Sec 3, T. 12 N., R. 21 E. One pit and an adit were found at the location. The adit (caved, estimated to be 50 m long) was excavated in a southerly direction, along an iron oxide-stained shear zone in limestone country rock. No significant concentrations of metallic elements were found in a sample (IPB-24) from the dump of the adit.

Mahogany Hill Prospect

The property is on the north facing slope of the Grouse Creek drainage, between 2,150 and 2,250 m elevation, in the SW1/4 SW1/4 Sec 31, T. 31 N., R. 22 E. The workings (one caved adit estimated to be 20 m long, one 10-m-long adit, four pits, and one trench) explore a southeast-trending, iron oxide-stained silicified zone, probably associated with a narrow volcanic dike, in dark gray limestone or dolomite.

Four samples from the workings (IPB-10-13) contained up to 148 ppm copper and 1,345 ppm zinc. A 1-m-long chip sample taken previously from a shear zone in the 10-m-long adit contained 0.8 ppm silver, 170 ppm copper, and 2,100 ppm zinc (McHugh and others, 1991). Although the concentrations are significant, none are economic and too little information on the mineralizing structure is available to infer resources.

Hill Top Prospect

A group of four claims in sec. 11, T. 11 N., R. 21 E. were located in 1966 by Stanton D. Young. According to May 1993, BLM mining claim records the last assessment work was recorded in 1990 and the case file was closed in 1992.

The only workings found in the vicinity of the claims were very shallow pits along the ridge where iron oxide-stained quartz veinlets and narrow silicified shear zones crossed it. The zones are in mudstone of the Mississippian McGowan Creek formation. Three samples (IPB-43-45) from the locality contained up to 1,140 ppm lead and 6,350 ppm zinc. Although the concentrations are significant, none are economic.

Dolomite

Dolomite is the main constituent of several geologic formations in the study area where it underlies more than 30 km^2 (fig. 3). Analyses of samples from outside and within the study area (Mapel and others, 1965; Ross, 1947, p. 1118) show some of the dolomite is relatively pure. Their analyses indicate that the Jefferson dolomite contains the most pure strata, with MgO (magnesia) content ranging from approximately 20 to 22 percent and insoluble contaminants of 2 percent or less. Sediments at the base of the Jefferson dolomite and the underlying and overlying sediments (the Laketown and Grandview dolomites) contain higher percentages of contaminants and lower percentages of MgO.

A reserve base exceeding 1 billion tonnes of dolomite suitable for metallurgical purposes is inferred within the study area. Bennett (1944, p. 6-7) states that ". . . for production of magnesium metal, . . . rock . . . with no more than 3 percent impurities such as silica, iron, and alumina, and with no less than 20 percent magnesia, is preferred." A supplement to Bennett's report (Washington State Division of Geology, 1944) contains analyses of dolomite from an area presently (1993) being mined near Addy, Wash., that show an average grade there of 21.3 percent MgO, with 1.63 percent insoluble contaminants. In 1993, the processing plant at Addy was the only producer of magnesium metal from dolomite in the United States. The Pahsimeroi study area dolomites fall within these grade parameters.

Limestone

The Devonian Three Forks and the Mississippian-age limestones include more than 1,500 vertical meters of limestone that varies from siliceous, to dolomitic, to relatively pure. The limestone is exposed in an area of more than 100 km^2 within the study area (fig. 3). Analyses of samples from outside and within the study area (Mapel and others, 1965; Ross, 1947, p. 1118) indicate that the Mississippian-age limestone contains strata with as little as 1 percent insoluble contaminants and less than 1 percent MgO, which is an undesirable constituent for some limestone uses. Other beds within it and the Three Forks limestones contain both higher percentages of insoluble contaminants and/or higher percentages of MgO.

Analyses and geologic maps show that an inferred reserve base exceeding 1 billion tons of limestone suitable for a variety of uses exists within the study area. According to Mapel and others (1965), some of the strata in the study area are of very high purity, less than 1 percent contaminants and 1 percent MgO, and are

possibly suitable for high-grade uses. Other strata contain minor contaminants but are suitable for many other uses. Boynton (1980, p. 95-158, 380-486) discusses a variety of uses for limestone and lime, the allowable impurities, and milling requirements. Some of the uses include portland cement, aggregate, slag and fluxes for iron and steel manufacture, glass, pulp, paper, whiting, pigments, and several agricultural uses.

Sand and Gravel

Sand and gravel are widespread in the study area and vicinity. The material is mostly in Quaternary and Pleistocene alluvial fans and glacial till containing fragments of the surrounding mountains. The alluvial fans were deposited by streams draining the Pahsimeroi Mountains. The fans extend well beyond the study area boundary; ranging up to several kilometers long and wide and tens to hundreds of meters thick. Material in the study area is similar to road fill and crushed aggregate mined intermittently at Idaho Department of Transportation material sites throughout the state; however, mining the sand and gravel inside the study area is unlikely because of the abundance nearby of equally good or better material closer to existing and foreseeable markets.

Geothermal Energy

Faults, such as underlie the study area, can localize geothermal energy, but no surface expressions of such energy were identified. Thermal springs within 10 km of the Pahsimeroi study area flow at temperatures up to 50° C.; too low for most geothermal energy uses. Some are warm enough to be suitable as a source of heat for small domestic heat pumps (Dean Howell, Kool-Fire West, Spokane, Wash., oral communication 1988), but markets are not predicted.

Oil and Gas

There is little surface indication of oil and gas potential in the Pahsimeroi study area. Rich source rocks may have existed there; however, sedimentary rocks in the region have been heated to high enough temperatures to convert liquid hydrocarbons to gases. Although gases released by thermal degradation may have been trapped in structurally or stratigraphically favorable sites, no evidence of oil and gas was found. Sandberg (1983, p. F4) classified potential for oil and gas in this region as low to zero and stated " This rating could be reduced or substantially increased, depending on the results of any future drilling...".

Chalcedonic Nodules

Hollow, translucent, white to tan chalcedonic nodules with banded layering to 2 cm thick were found in two areas in the study area (fig. 2). They were noted along Forest Road 110, about 2 km northwest and 2 km south of the top of Table Mountain. The interior of the nodules collected from the areas were commonly coated with

quartz crystals to 1 cm wide and one specimen (from sample locality 25) displayed a distinct, milky, light-purple color, reportedly caused by minute concentrations of manganese (Thrush, 1968, p. 34) and commonly referred to as amethyst or amethystine.

Placer Materials

Significant concentrations of useful placer minerals, including base or precious metals, were not found in any of the samples from within or adjacent to the study area (appendix 2).

Christian Gulch Prospect

Two small prospect pits were found in Christian Gulch, in the NW1/4 SW1/4 sec. 3 and SW1/4 NW1/4 sec. 10, T. 11 N., R. 22 E. Two samples from the pits (IPB-1 and -39) contained no significant concentrations of metallic elements.

CONCLUSIONS

Significant concentrations of gold, copper, lead, zinc,and barium occur in the study area. Workings at the sites are generally caved and the mineralized structures are poorly exposed; resources could not be delineated. Element concentrations at these sites do not necessarily denote economic significance; contents may be so low or so intermixed with other material that mining would not be profitable. However, all of the samples were from surface or near-surface material and may not directly represent the grade of materials at minable depths, mainly because of weathering.

Both the limestone and dolomite found in the area have been used as rip-rap, aggregate, and possibly for building stone and for the manufacturing of portland cement. This minor, local demand for limestone and dolomite, and for limited amounts of sand and gravel in the study area, could continue in the future. While occurrences just outside the study area are numerous and of sufficient size to supply demand, most of the adjacent limestone and dolomite resources have also been proposed for wilderness designation (Gabby, 1986; Capstick, 1987; Miller, 1989; and Peters, 1993). Extensive sampling and more detailed mapping would be required to better delineate the dolomite and limestone resources.

Resources are inferred for sand and gravel, limestone (for a variety of uses), and dolomite (for magnesium metal production). If markets and other conditions favoring mining these commodities from the study area develop, additional sampling and use-specific testing would be necessary. Minability of these commodities is dependent upon several factors besides quality and quantity. Markets must exist or, preferably, be expanding. Transportation costs must be minimized. Zoning and political restrictions must be favorable. Many companies using commodities such as limestone (or marble) own raw-material sources near their operations, and these sources are usually sufficient for decades or centuries of production. Many companies using

outside sources have customized their processes to fit their sources and are unwilling to switch providers, even if a new supplier can offer lower costs. Thus, sand and gravel, dolomite, and limestone in the study area may exist in large quantities at favorable grades, but not be minable in the near future. Such materials represent a stockpile for which reserves may be calculated only if marketing, transportation, and other conditions become favorable.

Although the chalcedonic nodule occurrences are of little or no economic value, they may be of interest to hobbyists who cut and polish stones.

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APPENDIX A.--Descriptions and analyses of rock samples from the Pahsimeroi study area, Custer County, Idaho.

(ppb, part per billion; ppm, part per million; <, less than; do, same as above; cm, centimeter; m, meter; %, percent)

Sample			Au	Ag	Cu	Pb	Zn	As	Sb	W	Mn	Bi	Mo	Hg	Ba
Number	Type	Description	(ppb)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppb)	(ppm)
IPB-5	Select	Iron oxide-stained quartz and iron oxide boxwork to 10 cm thick; from fracture filling in limestone country rock.	52	1.6	36	525	1730	58	<5	15	112	<5	20	705	302
IPB-7	do	Iron oxide-stained quartz from vein in dark-gray limestone float.	35	1.1	16	72	93	75	<5	<10	130	<5	5	2310	280
IPB-10	do	Iron oxide-stained quartz and dolomite.	295	.4	96	12	305	30	<5	<10	308	<5	6	140	1130
IPB-11	Grab	Fine-bedded, fine-grained, argillaceous metasediment transected by iron oxide-coated quartz stringers.	10	.2	147	6	875	41	<5	<10	242	<5	<1	125	1175
IPB-12	do	do	12	.4	148	17	1140	31	<5	10	36	<5	1	135	1150
IPB-13	Select	Iron oxide-coated and -stained quartz breccia.	20	.2	36	2	1345	30	<5	12	320	<5	8	150	295
IPB-16	do	Iron oxide-coated and -stained quartz breccia with calcite and barite crystals and coatings; from float, 64 to 128 m S. 32° E. of the pit at sample locality IPB-19.	123	.5	87	460	135	1245	21	<10	138	<5	20	525	1.6%
IPB-17	do	Iron oxide-coated and -stained quartz breccia with calcite and barite crystals and coatings; from float, 0 to 64 m S. 32° E. of the pit at sample locality IPB-19.	<5	<.2	14	82	13	2730	58	<10	107	<5	2	1280	9.2%
IPB-18	do	Iron oxide-coated and -stained quartz breccia with calcite and barite crystals and coatings; from float, 0 to 210 m N. 32° W. of the pit at sample locality IPB-19.	<5	<.2	40	91	105	6450	20	<10	98	<5	45	1225	9015
IPB-19	do	Iron oxide-coated and -stained quartz and volcanic breccia with calcite, barite, and magnetite crystals and coatings; from a pit in a N. 32° W. striking, N. 10° E. dipping, yellow-weathering layer of limestone in Jefferson dolomite.	5	<.2	42	57	60	1660	10	<10	30	<5	10	715	17%
IPB-20	do	Iron oxide-coated and -stained quartz breccia with calcite and barite crystals and coatings; from float, 0 to 100 m S. 5° E. of the pit at sample locality IPB-21.	<5	<.2	14	62	170	2750	24	<10	197	<5	12	860	8.6%

APPENDIX A.--Descriptions and analyses of rock samples from the Pahsimeroi study area, Custer County, Idaho--Continued.

(ppb, part per billion; ppm, part per million; <, less than; do, same as above; cm, centimeter; m, meter; %, percent)

Sample			Au	Ag	Cu	Pb	Zn	As	Sb	W	Mn	Bi	Mo	Hg	Ba
Number	Type	Description	(ppb)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppb)	(ppm)
IPB-21	Select	Iron oxide and magnetite; from the vicinity of a sloughed 2-m-wide, 4-m-long, 0.5-m-deep pit on a brecciated zone striking N. 5° W. and dipping 5° NE. in Jefferson dolomite.	<5	<0.2	20	150	172	9240	26	<10	75	<5	27	750	4.1%
IPB-22	do	Quartz and opaline material; from the vicinity of the pit at sample locality IPB-21.	25	<.2	19	138	112	1455	12	<10	72	<5	8	585	2.8%
IPB-23	do	Silicified breccia; from the vicinity of the pit at sample locality IPB-21.	<5	<.2	37	93	251	2765	11	<10	102	<5	10	1080	2.1%
IPB-24	do	Brecciated limestone cemented with iron oxide and transparent to black calcite crystals; from the dump of a caved, south-trending adit estimated to be 50 m long.	<5	<.2	11	2	180	158	<5	<10	510	<5	<1	35	462
IPB-27	do	Iron oxide-stained rhyolitic breccia; from a 6-m-long dozer trench.	<5	<.2	5	18	85	12	<5	<10	112	<5	<1	115	203
IPB-28	do	Iron oxide-stained rhyolitic breccia; from a 4-m-long dozer trench.	<5	<.2	7	4	45	5	<5	<10	140	<5	<1	50	410
IPB-29	Grab	Welded tuff, jasperoid, siliceous sinter, and barite intruding along bedding, striking N. 10° W., dipping 10° SW., in dolomitic country rock; from a 2 by 3 m pit, 0.5 m deep.	<5	<.2	20	16	21	38	<5	<10	58	<5	<1	260	3.7%
IPB-30	Select	Multicolored jasperoid float.	<5	<.2	18	24	19	46	<5	<10	85	<5	<1	115	675
IPB-31	Grab	Massive, coarse-grained, light-weight, tan welded tuff; from the dump of a sloughed 5-m-long trench.	<5	<.2	3	12	27	<5	<5	<10	278	<5	<1	15	2380
IPB-32	do	Poorly bedded, medium-grained, tan to gray welded tuff; from the dump of a sloughed 4-m-long trench.	<5	<.2	6	14	31	<5	<5	<10	260	<5	<1	30	1275
IPB-33	do	Massive, fine-grained, tan welded tuff; from the dump of a sloughed 10-m-long trench.	<5	<.2	3	10	22	<5	<5	<10	152	<5	<1	15	1650
IPB-34	Select	Angular quartzite clasts cemented with brick-red, porous-to-jasperoid sinter.	15	<.2	5	18	8	25	38	<10	53	<5	1	45	80
IPB-35	Grab	Jasper float.	92	<.2	6	9	5	11	12	<10	45	<5	1	80	585

APPENDIX A.--Descriptions and analyses of rock samples from the Pahsimeroi study area, Custer County, Idaho--Continued.

(ppb, part per billion; ppm, part per million; <, less than; do, same as above; cm, centimeter; m, meter; %, percent)

Sample			Au	Ag	Cu	Pb	Zn	As	Sb	W	Mn	Bi	Mo	Hg	Ba
Number	Type	Description	(ppb)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppb)	(ppm)
IPB-37	Select	Jasperoid, angular quartzite, and iron oxide-stained quartzite clasts cemented with brick-red, porous-to-jasperoid sinter; in float.	12	<0.2	11	16	14	13	32	<10	60	<5	2	60	187
IPB-43	do	Iron oxide-stained sinter; in float.	8	.2	84	1140	6350	90	<5	70	520	<5	10	410	335
IPB-44	do	Slightly silicified, highly iron oxide-stained, silty limestone.	35	.8	110	22	1940	16	<5	25	2035	<5	5	275	540
IPB-45	do	Slightly iron oxide-stained quartz and silicified silty limestone.	25	.2	27	9	60	420	8	<10	110	<5	1	620	1175

APPENDIX B.--Descriptions of placer samples and analyses of concentrates.

(ppb, part per billion; ppm, part per million; m^3, cubic meter; %, percent; >, greater than; cm, centimeter; mm, millimeter; <, less than; do, same as above)

Sample			Au	Ag	Cu	Pb	Zn	As	Sb	W	Mn	Bi	Mo	Hg	Ba
Number	Volume	Description	(ppb)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppb)	(ppm)
IBP-1	0.034 m^3	80% >10 cm, 10% >1 cm, 5% >1 mm, 5% <1 mm; 90% limestone, 5% calcite, 5% chert.	<5	<0.2	10	16	54	5	<5	<10	118	<5	2	130	126
IBP-2	.009 m^3	20% >10 cm, 30% >1 cm, 25% >1 mm, 25% <1 mm; 90% limestone, 5% calcite, 5% chert.	<5	<.2	6	4	38	<5	<5	<10	70	<5	1	65	23
IBP-3	.007 m^3	5% >10 cm, 45% >1 cm, 30% >1 mm, 20% <1 mm; 95% limestone and dolomite, 5% chert.	5	.3	50	38	215	13	<5	<10	268	<5	2	155	1510
IBP-4	.014 m^3	50% >10 cm, 25% >1 cm, 20% >1 mm, 5% <1 mm; 95% limestone and dolomite, 5% chert, trace barite.	8	.8	66	30	250	18	<5	<10	275	<5	2	210	4620
IBP-6	.011 m^3	40% >10 cm, 30% >1 cm, 20% >1 mm, 10% <1 mm; 85% siltstone, 10% shale, 4% volcanic rocks, 1% quartz.	<5	<.2	15	11	133	9	<5	<10	158	<5	1	95	705
IBP-8	.014 m^3	50% >10 cm, 20% >1 cm, 20% >1 mm, 10% <1 mm; 50% siltstone, 50% limestone, trace quartz.	<5	<.2	32	12	156	8	<5	<10	180	<5	1	100	1075
IBP-9	.017 m^3	60% >10 cm, 25% >1 cm, 10% >1 mm, 5% <1 mm; 50% siltstone, 50% dolomite.	<5	<.2	21	25	172	10	<5	<10	615	<5	2	135	1080
IBP-14	.008 m^3	10% >10 cm, 50% >1 cm, 35% >1 mm, 5% <1 mm; 90% limestone, 10% argilaceous limestone.	<5	.4	8	10	118	7	<5	<10	243	<5	1	120	462
IBP-15	.010 m^3	30% >10 cm, 30% >1 cm, 30% >1 mm, 10% <1 mm; 90% limestone, 5% argilaceous limestone, 3% gossan, 2% quartzite and vein quartz.	7	.4	39	26	332	34	<5	<10	670	<5	2	140	3.30%
IBP-26	.010 m^3	30% >10 cm, 30% >1 cm, 30% >1 mm, 10% <1 mm; 80% volcanic rocks, 20% quartzite.	5	<.2	22	27	57	7	<5	<10	710	<5	2	90	925
IBP-36	.008 m^3	10% >1 cm, 30% >1 mm, 60% <1 mm; 20% jasperoid and quartzite, 80% red soil.	<5	<.2	23	50	51	17	<5	<10	725	<5	2	435	895
IBP-38	.009 m^3	20% >10 cm, 40% >1 cm, 10% >1 mm, 30% <1 mm; 90% limestone, 5% chert, 3% jasperoid, 2% quartz and calcite.	<5	<.2	6	<2	42	<5	<5	<10	50	<5	<1	40	25
IBP-39	.009 m^3	20% >10 cm, 30% >1 cm, 40% >1 mm, 10% <1 mm; 95% limestone, 5% calcite.	<5	<.2	11	25	152	7	<5	<10	88	<5	1	65	52

APPENDIX B.--Descriptions of placer samples and analyses of concentrates--Continued.

(ppb, part per billion; ppm, part per million; m^3, cubic meter; %, percent; >, greater than; cm, centimeter; mm, millimeter; <, less than; do, same as above)

Sample			Au	Ag	Cu	Pb	Zn	As	Sb	W	Mn	Bi	Mo	Hg	Ba
Number	Volume	Description	(ppb)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppb)	(ppm)
IBP-40	.008 m^3	30% >10 cm, 30% >1 cm, 30% >1 mm, 10% <1 mm; 95% limestone, 5% calcite.	10	0.2	22	10	160	10	<5	<10	295	<5	2	210	23
IBP-41	.008 m^3	30% >10 cm, 30% >1 cm, 30% >1 mm, 10% <1 mm; 95% limestone, 5% chert.	10	.2	9	11	114	9	<5	<10	283	<5	1	125	258
IBP-42	.008 m^3	30% >10 cm, 30% >1 cm, 30% >1 mm, 10% <1 mm; 95% limestone, 5% chert.	<5	<.2	14	10	110	25	<5	<10	202	<5	2	80	192
IBP-46	.014 m^3	50% >10 cm, 20% >1 cm, 25% >1 mm, 5 % <1 mm; 85% limestone and dolomite, 10% chert, 5% quartz and calcite.	5	<.2	9	10	68	23	<5	<10	215	<5	2	75	2160
IBP-47	.010 m^3	30% >10 cm, 30% >1 cm, 30% >1 mm, 10% <1 mm; 60% volcanic rocks, 40% quartzite.	6	<.2	26	57	58	65	10	15	2350	<5	2	160	1250
IBP-48	.010 m^3	30% >10 cm, 20% >1 cm, 40% >1 mm, 10% <1 mm; 90% volcanic rocks, 6% quartzite, 3% limestone and dolomite, 1% jasperoid and quartz.	<5	<.2	28	11	60	21	<5	<10	855	<5	1	75	835
IBP-49	.010 m^3	30% >10 cm, 30% >1 cm, 35% >1 mm, 5% <1 mm; 70% dolomite and limestone, 20% volcanic rocks, 5% chert, 5% jasperoid.	<5	<.2	14	43	44	152	16	17	475	<5	4	145	950
IBP-50	.011 m^3	40% >10 cm, 20% >1 cm, 35% >1 mm, 5% <1 mm; 100% volcanic rocks.	<5	<.2	11	10	28	<5	<5	<10	390	<5	<1	60	725